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Character of Innovations in Environmental Education

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Abstract

Environmental issues are frequently used nowadays as educational content. It brings together innovations in constant learning and improvement of students' education. Environmental education is focused on the complex relationships between the population and the environment. It is a field of study that brings new knowledge and challenges each day. The methodologies of the research in this field, as well as its realisation and the process of production are different. The basis is good knowledge, an overview of the analysis used and good orientation, as well as reviews in the field of environmental studies. Students have many opportunities to cooperate in research preparation and also in the research area. They can participate in the implementation of the results into real work. With the help of different stimuli and motivational elements, teachers and students can create an educational situation that motivates action, as well as education, in the environment. It is difficult to educate future graduates to have a positive attitude about the environment; this needs good motivation and constant study of this field. The article deals with examples focused on environmental problems that have been dealt with in particular research activities of university students.

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Keywords: Environment; education; knowledge; motivation; Student Research and Professional Activities (SRPA);

1. Introduction

Environmental education brings exploring the unknown, continuous learning and improvement, constant education and communication, to students (Pedro, & Pedro, 2010). Nowadays, this connection is often used in various branches of research and education. Environmental issues provide students with unique experiences that allow them to actively participate in activities while promoting a positive attitude toward, and an increased interest in, science (Boyce, Mishra, Halverson, & Thomas, 2014). The methodology of research as well as its

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implementation and processing are different. Its basis is sufficient quality knowledge and a correct orientation and outlook in that field. Students today are more educated, thus they have more knowledge and information that they can use in their future practice. They have more access and opportunities to cooperate in developing research. This cooperation is particularly useful in engaging students in science activities (Boyce, Mishra, Halverson, & Thomas, 2014). Subsequently, they can participate in the implementation of results into practice. They understand and have access to a wide range of existing research techniques and the possibilities for their application. Qualitative research requires a variety of knowledge and information. The positive side is that, thanks to scientific and technical progress, its implementation now takes less time. However, the problem of determination, its solution and use in practice needs creativity and practical skills in students.

The limiting factors for future economic growth are not labour and technology (Hawken, 1997). They are, instead, natural capital (the size of the fish stock, not the number and size of the fishing boats) and social capital (the ability to make market corrections and to govern society to achieve health, peace, security, social equity, and stability) (Cortese, 2003).

Environmental issues have gained prominence today in various branches of society (Noga, 2008), because of the urgency and importance of this issue. From this perspective, education plays a decisive role in order to disseminate information that provides alternatives to mitigate the effects of worrying unsustainable natural resources (dos Santos, Moita Neto, & Alves de Abreu e Sousa, 2014). Learners, specifically younger children, do not spend enough time out in nature exploring and learning about the environment. Therefore, it is necessary to lead the younger generation in activities mentioned, to foster a positive relationship and caring about nature (Louv, 2005). That's why it is necessary to lead young generation to activities mentioned to get the positive relationship and caring about nature (Feszterova, 2014).

In this work, we report on the experience of disciplines oriented on chemistry and environmental education, taught disciplines for future teachers and bachelors, from the Constantine the Philosopher University in Nitra (Slovakia). With the knowledge gained in their work, students participated in Student Research and Professional Activities (SRPA). It was possible to ascertain the feasibility of discussing environmental issues for future graduates, in an interdisciplinary context. From the students' point of view it was necessary to understand the need to look at environmental issues in their future professional activity. The use of modern educational technology and active learning in environmental education is extremely important, as far as it can be used to provide effective training and professional orientation of students (Derevenskaia, 2014).

2. The highest educational level (University) - Fully Integrated System

Study programmes, such as the Teacher Training of Academic Subjects in combination with Chemistry and Environmental Chemistry aimed at future graduates in natural sciences, must be oriented on areas that respond to the needs of the current praxis. Higher education has unique academic freedom and the critical mass and diversity of skills to develop new ideas, to comment on society and its challenges, and to engage in bold experimentation in sustainable development (Cortese, 2003). (Fig. 1.) Education and scientific preparation focused on environmental status is the tool for constant development of science and special knowledge, as well as opinions, in this particular field (Ozden, 2008). Obtaining knowledge from the different disciplines of future graduates, focused on the environment, coupled with expansion of knowledge about the state of air, water, soil, fauna and flora and their pollution, is very important.

At the Department of Chemistry, Faculty Natural Sciences (FNS) in the Constantine the Philosopher University (CPU), Nitra (Slovakia), many students are taught two bachelors study programmes: Teacher Training of Academic Subjects in combination with Chemistry and Environmental Chemistry. During their bachelors studies over three to four years the students' daily study programme for these courses covers the subjects of chemistry, physics, mathematics, the environment and biology.

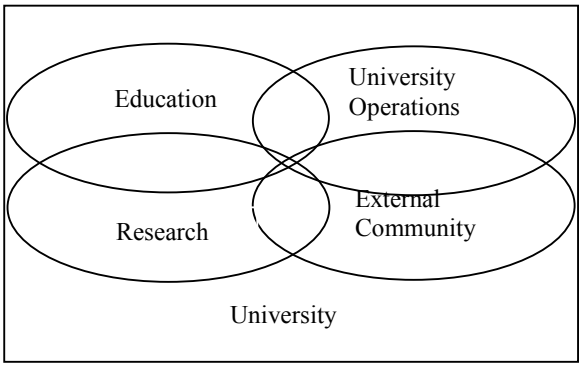

Fig. 1. Higher Education Modelling Sustainability As a Fully Integrated System (Cortese, 2003)

Students studied different types of courses, such as General Chemistry, Inorganic Chemistry, Chemical Calculation, Organic Chemistry Analytical Chemistry, Biochemistry, Physical Chemistry, Safe Working with Chemicals, Computer Network, Computer-Assisted Molecular Modelling in Chemistry, Analysis of Components of the Environment, Physics for Scientists, Ecosystem Ecology, System Approaches in Ecology, Environment of the SR, Environmental Monitoring, Bioethics, Basics of Plant Physiology and Genetics, Laboratory Control of Biological Products and Environmental Education, Chemistry of Synthetic Polymers, Gardening, Fauna in Landscape Research, Theory of the Chemical Bond, The Mathematical Basis for Chemists, Basis of Chemistry Didactic, and many laboratory exercises.

The students undertaking these study programmes were integrated in different activities that focused on air, water and soil pollution projects within Student Research and Professional Activities (SRPA). The projects were based on the knowledge and practical skills which students acquired during their studies.

3. Research orientation works in SRPA

The SRPA programme was created to improve student training and future practice. It is a programme that enables students to participate in projects in several scientific areas, one of which is the area of the environment. Participating students have the opportunity to take an active part in scientific and research work (Fig. 2.). They are inserted in different activities and work in different areas of the environment. They expand and develop the knowledge and information about the environment acquired during their school studies. The strategic aim of the project is to improve the perception and status of the environment in society, through the popularisation of scientific activities among students with an emphasis on the awareness of the specific role of the young generation to care for the environment. The aims of the project can be achieved through the development of existing study programmes and popularisation of such programmes that SRPA represents. The project consists of an educational committee, formed by teachers responsible for implementing and overseeing the professional activities and objectives of the project, and activity to popularise science among students who will be able to continue scientific activities in subsequent years. The project implements targeted activities, tools and activities supporting the promotion and popularisation of science and technology in the various study programmes, to have the greatest impact on students as a target group.

Students who participated in SRPA over the last 10 years have prepared the following works:

a) Education and training in the field of the environment covering: chemicals and their effects on the environment, negative effects of toxic substances on the environment, toxic pollution in the environment, environmental chemistry in hobby groups in primary schools, fertilizers and their influence on selected elements of the environment, methods for quality assessment and monitoring of environmental components – comparison of Slovakia and the Czech Republic, eco-analysis in environmental chemistry, chemistry focused on environmental education in primary schools, analysis of soil samples in teaching of chemistry, effectiveness of selected

chemical demonstration experiments focused on environmental sorption of heavy metals in selected components of the environment, and environmental problems and their impact on the environment;

b) The state of the air, including: air pollution in the Nitra region, selected particulate matters in the atmosphere, the impact of selected factors on the dispersion of pollutants (SO_2, NO_x) in the atmosphere, the impact of selected factors on the content of PM_{10} and $PM_{2.5}$ in the atmosphere of the city of Nitra, identification of the contamination of air at the local level, concentration of selected air pollutants in the city of Strazske, external concentration of selected air pollutants in the model area, pyrolysis of selected types of municipal solid waste, and the influence of selected factors on the dispersion of air pollutants;

c) Qualitative and quantitative characteristics of water, including: selected characteristics of water in the river Vah, wastewater treatment in WWTP Partizanske, observing of selected indicators in the Nitra river, monitoring of selected chemical characteristics in the water of alpine lakes, determination of surface water quality in selected water flow, anthropic contamination of selected watercourse, and determination of heavy metals by AAS in selected watercourses;

d) Determination of soil samples (various soil types and textures) such as: methods for determination of inorganic nitrogen in the soil, effect of sulphur on the accumulation of selenium in the soil, monitoring of selected characteristics of soils in the cadastres Trnovec nad Vahom and Sal'a, evaluation of changes of selected chemical characteristics of the soil, chemical characterisation of selected soil types, C_{ox} content in the soil, determination of pH in soil samples in the cadastre Horna Kral'ova, analysis of selected fractions of sulphur in the soil (cadastre Sal'a), methods of sulphur determination in the soil, and determination of heavy metals in the soil by Atomic absorption spectroscopy.

Research activity is based on teamwork and the use of knowledge from particular scientific disciplines, as well as on the ability to use the knowledge and information obtained in real practice, in the environment. The application of theoretical knowledge to activities focused on environmental protection allows better understanding of sustainability rules, skills, understanding of the biosphere, economic and ecological connections, and problems of the environment from local and global points of view. Individuals have not only to evaluate, but also they have to be qualified to act for the environment environment (Pedro, & Pedro, 2010). This is closely connected with the development of a relationship between people and the environment (Hilbert et al., 2009). It is not easy to apply chemical analysis methods with the aim of monitoring pollution in a selected area. In this case, the interdisciplinary approach is necessary. Equally, it is important to increase young people's interest in working in science, research and technology, and to support long-term cooperation and interaction with research institutes and the scientific community.

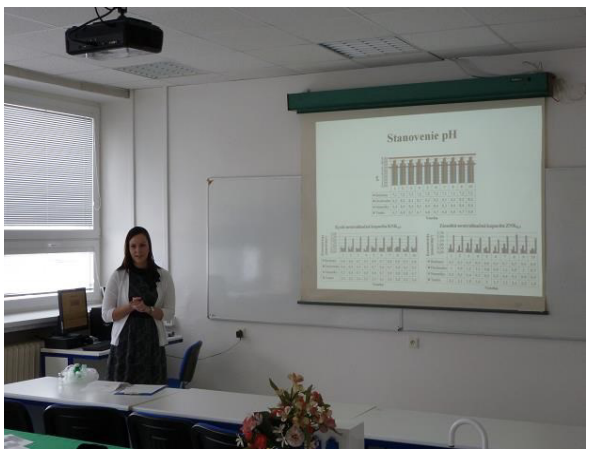

Fig. 2. SRPA at the Department of Chemistry, CPU in Nitra (2013) (Hudec, 2013)

4. Research results and discussion

Legislative measures (laws, rules, ordinances, regulations) provide protection against environmental pollutants and determine ways of monitoring the various substances in the environment. Countries' pollution includes unsorted waste landfills, waste incineration, transport, agriculture and industry (Chmielewska, & Kuruc, 2008). The chemical industry in the Slovak Republic is among one of the most important sectors of the economy, which contributes to improving the standard of living of the population. It is likely that in the future it will develop further. Environmental problems are associated with the development of chemistry and the chemical industry (Vollmannova et al., 2008; Hrnciarova, 2011). It is perceived that pollution is caused by air pollution (Caricchia, Chiavarini, & Pezza, 1999; Khlaifi et al., 2008; Ercelebi, & Toros, 2009), liquid and solid waste management, due to chemical plants and waste incinerators (Hegedüsova, Jomova, & Feszterova, 2008). There are nine areas with damaged or greatly damaged environments, which occupy 4,470 km^2 (9.12 %) (Hresko et al., 2012). In these areas, there are approximately 1,860,000 inhabitants (Dubcova et al., 2008).

The results that were obtained and published in SRPA are as follows:

- It is very important to constantly monitor the concentration of polluting matters in the environment and their impact. Monitoring of air, water and soil pollution represents a complex system that consists of data evaluation considering pollution of the environment and also the impact on human health.
- The biggest problems with air quality and the quantity of pollutants discharged into the environment are in large cities and industrial agglomerations. It is important to review the state of air pollution in selected regions in Slovakia. Polluted air from industry, energy and transport causes disease, not only to humans, but also the devastation of the surrounding countryside.
- It is important to control emissions with limits and quotas, technical demands, general conditions and requirements for pollutants discharged into the environment.
- Environmental care is not only observing the chosen factors in the air, soil and water, but also represents care of our forests which have lost more than 70 % of healthy trees, care of animals, many of which are endangered, care of the quality of waste water, because it is insufficient to simply clean sewage and waste water.

5. Conclusion

The development of human activities and accumulation of the results in nature constantly influences the environment and causes its deterioration. There are three basic issues affecting the environment: pollution and other forms of environmental degradation, distortion of the balance of ecological systems, and irrational use of natural sources.

The social and economic results of environmental destruction may affect the following areas: destabilisation of geobiocoens as a result of ecological breakdown, harm to the health of the population, and damage to buildings and machines (Spisiak, 2000). The students who take part in SRPA are well-informed in particular fields of study, they know how industry and traffic damages the environment. All available sources were used: articles in newspapers and magazines, and the Internet. They know how to use the new technologies and often cooperate with factories and research centres. They have the chance to present the results obtained in the SRPA programme, which requires good research. Work on the project is completed with the preparation of a manuscript and presentations (Derevenskaia, 2014). During the students' work in analysing and processing of results they can find the causes of negative impacts in the environment. Students with good motivation are excited by their research (Stoffova, & Valent, 2014). The teacher plays an important part in this. His or her aim is not only to choose the right research area, but also to choose the right methodology and find a good use for the results in practice.

Good results are the basis for good research. They become equal partners of their teachers. What they learn, they pass on; they keep trying to make their work attract attention and interest, and they want to be understood and receive positive feedback. The CPU in Nitra prepares students in disciplines that can be used in future work. Education improves all the time. New disciplines are being added, which include new research and new methods. Nowadays, all people have a negative impact on the environment. The rapid changes in industry and technology have caused various environmental problems (Alaydin, Demirel, Altin, & Altin, 2013); that is why it is necessary to educate the new generation who will try to improve our environment. The positive thing is the fact that the number

of students who care about the environment is rising. Typically, these young people's activities involve trying to monitor the quality of the environment, for example taking part in SRPA focused on environmental monitoring. Scientific and research development has led to an increasing interest in scientific and educational innovation (Feszterova, 2015).

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